RCA INDUSTRIAL TRANSISTORS

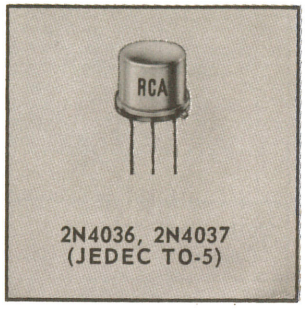
2N4036
2N4037

RCA-2N4036* and 2N4037** are double-diffused, epitaxial-planar, silicon p-n-p transistors. Both of these devices employ the popular TO-5 package but they differ in breakdown-voltage ratings, leakage-current, and saturation-voltage values.

These transistors are intended for a wide variety of small-signal, medium-power applications. With a minimum gain-bandwidth product (f_T) of 60 Mc/s, both of these transistors will provide useful gain at frequencies in the HF region. In addition, the 2N4036 is recommended for use in high-speed saturated switching applications.

* Formerly Dev. Type TA2651 ** Formerly Dev. Type TA2670
▲ 2N2102 is a linear beta type; the 2N3053 is a general-purpose type. For technical bulletins for these devices, write to Commercial Engineering at the address given below.

SILICON P-N-P POWER TRANSISTORS



2N4036, 2N4037
(JEDEC TO-5)

General-Purpose Types for Military, Industrial, and Commercial Applications

2N4036, 2N4037 — P-N-P Complements of: 2N2102, 2N3053 ▲

- **Planar construction provides low-noise and low-leakage characteristics**
- **Gain-bandwidth product (f_T) = 60 Mc/s min.**
- **High breakdown voltages:**
  BV_{CBO} = −90 V min. (2N4036)
  −60 V min. (2N4037)
  BV_{EBO} = − 7 V min. (2N4036, 2N4037)
- **Low saturation voltages:**
  V_{CE} (sat) = −0.65 V max. (2N4036)
  = −1.4 V max. (2N4037)
- **High pulse beta at high collector current:**
  h_{FE} = 20 min. at I_C = 500 mA (2N4036)
- **High saturated switching speed:**
  t_{on} = 110 ns max.
  t_{off} = 700 ns max. } (2N4036)

NEW! Maximum area-of-operation curves for DC and pulse operation.

MAXIMUM RATINGS

	2N4036	2N4037	
Absolute-Maximum Values:			
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	−90	−60	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With 1.5 volts (V_{BE}) of reverse bias, $V_{CEV(sus)}$	−85	−60	V
With external base-to-emitter resistance (R_{BE}) ≤ 200 Ω, $V_{CER(sus)}$	−85	−60	V
With base open, $V_{CEO(sus)}$	−65	−40	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	− 7	− 7	V
COLLECTOR CURRENT, I_C	−1.0	−1.0	A
BASE CURRENT, I_B	−0.5	−0.5	A
TRANSISTOR DISSIPATION, P_T:			
At case temperatures up to 25°C	7	7	W
At free-air temperatures up to 25°C	1	1	W
At temperatures above 25°C	See Fig.1.		
For pulse operation	See Fig.2.		
TEMPERATURE RANGE:			
Storage & operating (junction)	−65 to 200		°C
LEAD TEMPERATURE (During soldering) . . .			
At distances ≤ 1/32 in. from seating plane for 10 s max.	230		°C

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ELECTRICAL CHARACTERISTICS

Case Temperature (T_C) = 25° C

Characteristic	Symbol	TEST CONDITIONS							LIMITS				Units
		DC Collector Voltage (V)		DC Emitter or Base Voltage (V)		DC Current (mA)			Type 2N4036		Type 2N4037		
		V_{CB}	V_{CE}	V_{EB}	V_{BE}	I_C	I_E	I_B	Min.	Max.	Min.	Max.	
Collector-Cutoff Current	I_{CBO} I_{CEO}	–60	–30				0	0	– –	–0.02 –0.5	– –	–0.25 –5	μA μA
Emitter-Cutoff Current	I_{EBO}			–5		0			–	–0.02	–	–1	μA
Collector-to-Base Breakdown Voltage	BV_{CBO}					–0.1	0		–90	–	–60	–	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}					0	–0.1		–7	–	–7	–	V
Collector-to-Emitter Sustaining Voltage: *(See Figs. 3 & 4)* With base-emitter junction reverse biased	$V_{CEV}(sus)$				1.5	–100			–85●	–	–60●	–	V
With external base-to-emitter resistance (R_{BE}) ≤ 200 Ω	$V_{CER}(sus)$					–100			–85●	–	–60●	–	V
With base open	$V_{CEO}(sus)$					–100			–65●	–	–40●	–	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					–150		15	–	–0.65	–	–1.4	V
Base-to-Emitter Voltage	V_{BE}		–10			–150			–	–1.1	–	–1.5	V
DC Forward-Current Transfer Ratio	h_{FE}		–10 –10 –10 –10			–0.1 –1.0 –150* –500*			20 – 40 20	– – 140 –	– 15 50 –	– – 250 –	
Small-Signal, Forward-Current Transfer Ratio (at f = 20 Mc/s)	h_{fe}		–10			–50			3.0	–	3.0	–	
Output Capacitance	C_{ob}	–10							–	30	–	30	pF
Input Capacitance	C_{ib}			–0.5					–	90	–	90	pF
Sat. Switching Time: *(See Figs. 8 & 9)* Turn-on Time	t_{on}		–30			–150		–15	–	110	–	–	ns
Turn-off Time	t_{off}		–30			–150		–15	–	700	–	–	ns
Thermal Resistance: Junction-to-Case	Θ_{J-C}								–	25	–	25	°C/W
Junction-to-Free Air	Θ_{J-FA}								–	165	–	165	°C/W

●CAUTION: The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig.3.

*Pulsed; pulse duration = 300 μs, duty factor < 2%.

DISSIPATION DERATING CURVE FOR TYPES 2N4036 & 2N4037

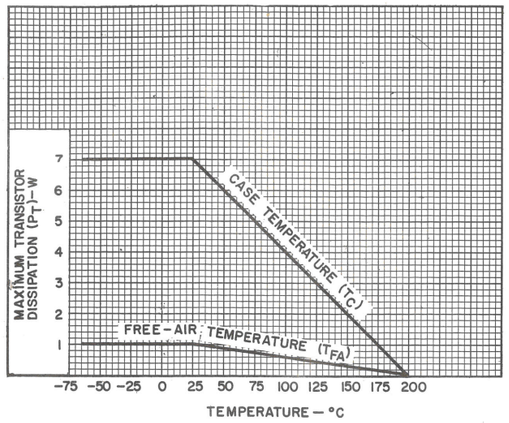


Fig. 1

CIRCUIT USED TO MEASURE SUSTAINING VOLTAGES $V_{CEO}(sus)$, $V_{CER}(sus)$, & $V_{CEV}(sus)$ FOR TYPES 2N4036 & 2N4037

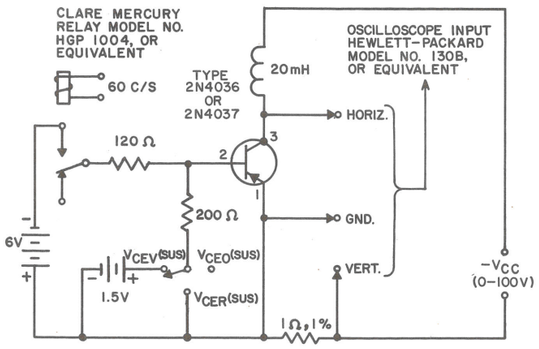


Fig. 3

SUSTAINING VOLTAGE vs. BASE-TO-EMITTER RESISTANCE FOR TYPES 2N4036 & 2N4037

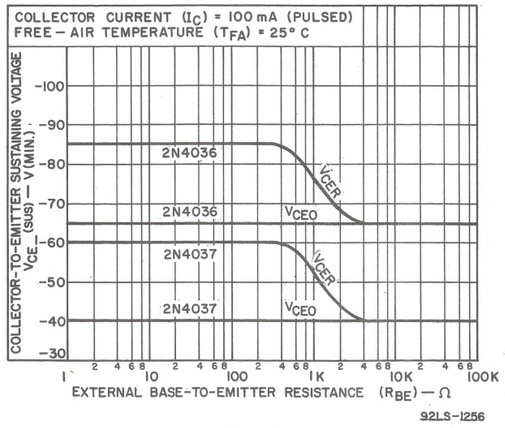


Fig. 5

MAXIMUM OPERATING AREAS FOR TYPES 2N4036 & 2N4037, PULSE CONDITIONS

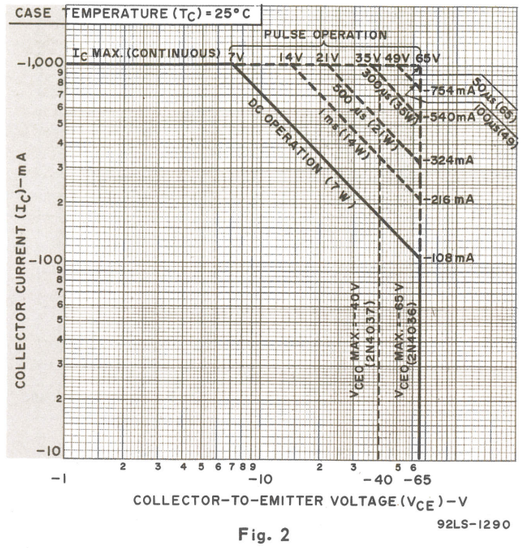
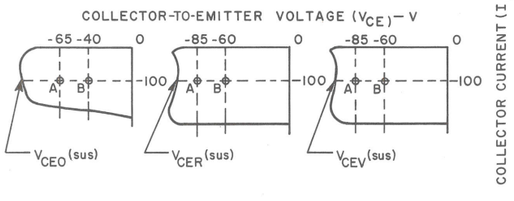


Fig. 2

OSCILLOSCOPE DISPLAY FOR MEASUREMENT OF SUSTAINING VOLTAGES (TEST CIRCUIT SHOWN IN FIG.3)



NOTE: The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ are acceptable when the traces fall to the left and below points "A" and "B" for types 2N4036 and 2N4037, respectively.

Fig. 4

TYPICAL SMALL-SIGNAL-BETA CHARACTERISTIC FOR TYPES 2N4036 & 2N4037

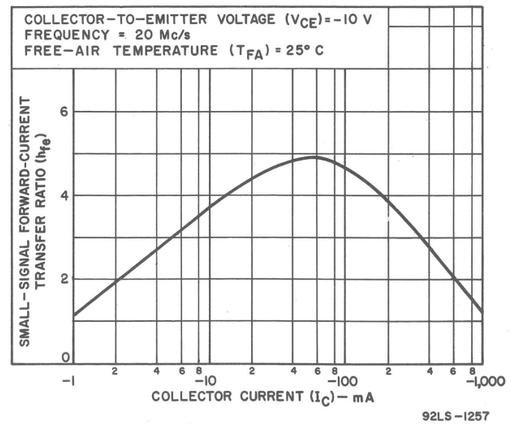


Fig. 6

TYPICAL DC-BETA CHARACTERISTICS FOR TYPES 2N4036 & 2N4037

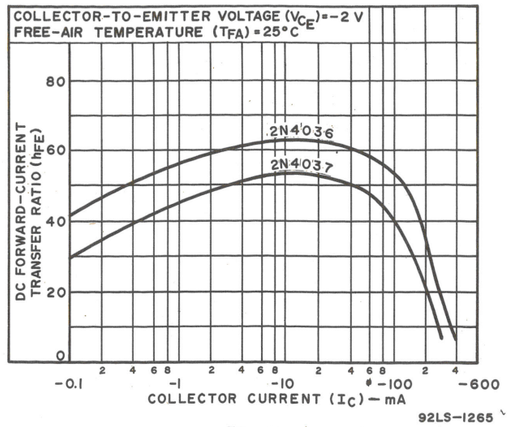


Fig. 7

CIRCUIT USED TO MEASURE SWITCHING TIMES FOR TYPE 2N4036

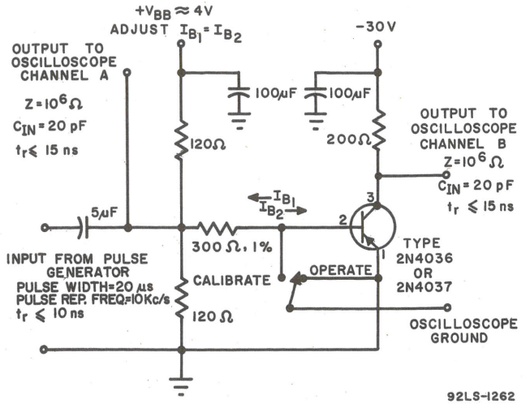
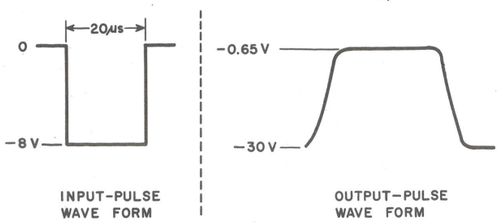


Fig. 8

OSCILLOSCOPE DISPLAY FOR MEASUREMENT OF SWITCHING TIMES (TEST CIRCUIT SHOWN IN FIG.8)



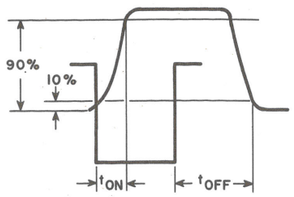


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Fig. 9

TYPICAL SATURATED SWITCHING TIMES FOR TYPE 2N4036

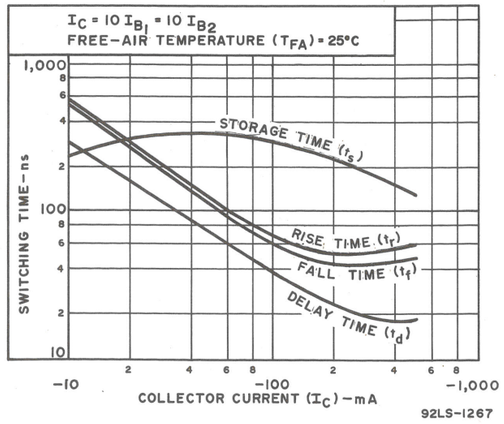

Fig. 10

TYPICAL COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTICS FOR TYPE 2N4036

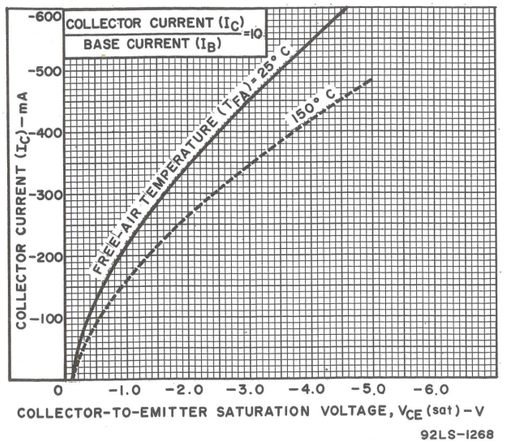
COLLECTOR CURRENT (I_C) / BASE CURRENT (I_B) =10
FREE-AIR TEMPERATURE (T_{FA}) = 25° C
150° C
COLLECTOR CURRENT (I_C)—mA
COLLECTOR-TO-EMITTER SATURATION VOLTAGE, $V_{CE(sat)}$—V
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Fig. 11

TYPICAL COLLECTOR-CUTOFF CURRENT vs. JUNCTION TEMPERATURE FOR TYPE 2N4036

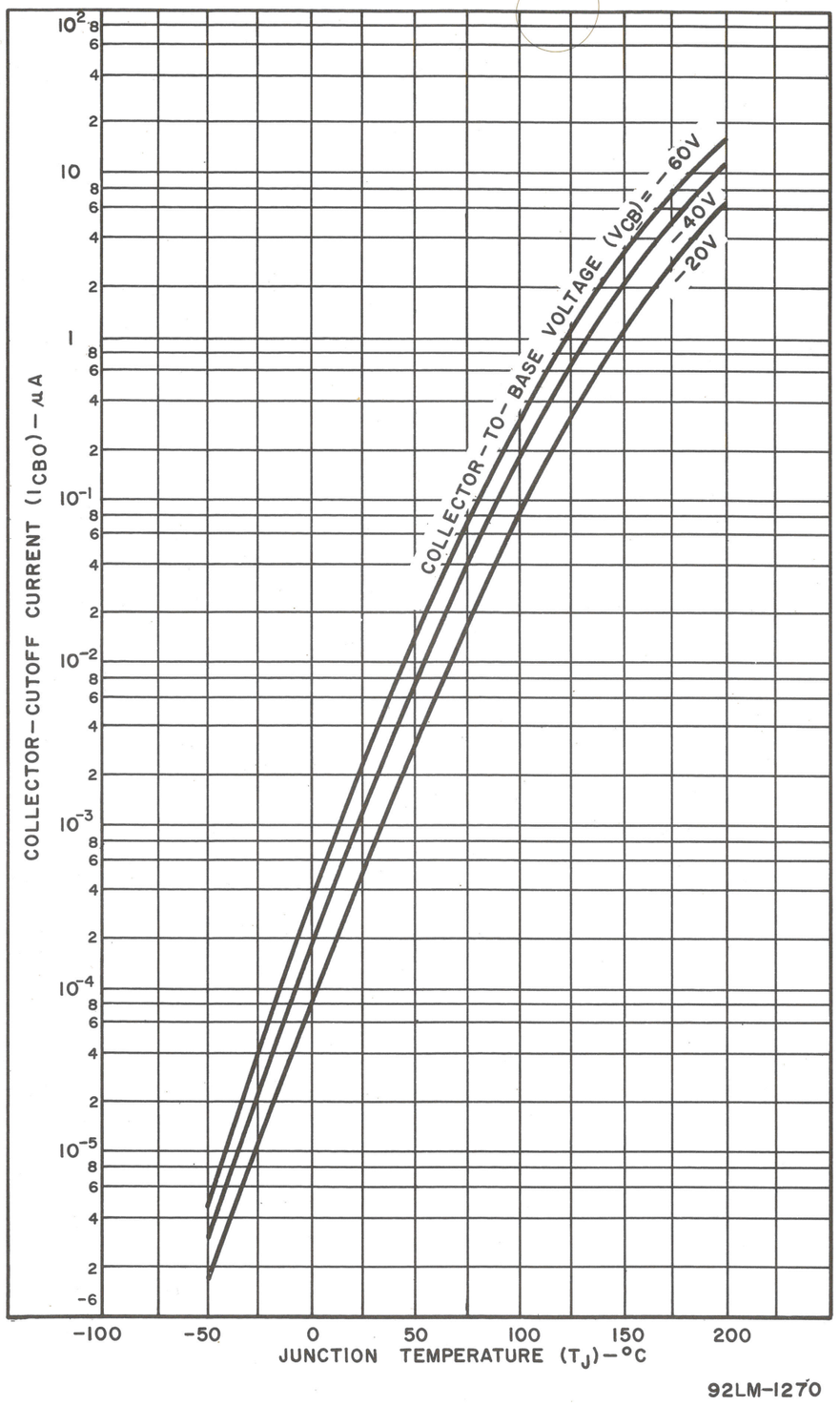

Fig. 12

TYPICAL COLLECTOR CHARACTERISTICS
FOR TYPE 2N4037

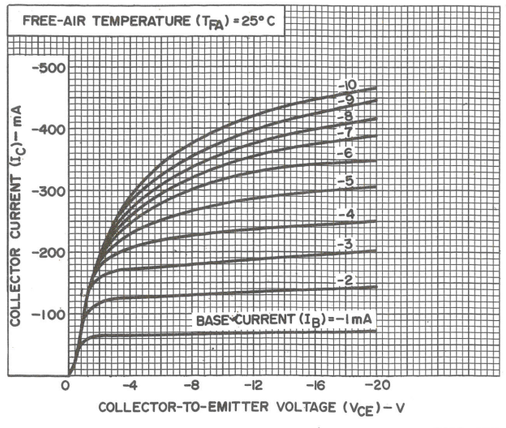

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Fig. 13

TYPICAL COLLECTOR CHARACTERISTICS
FOR TYPE 2N4037

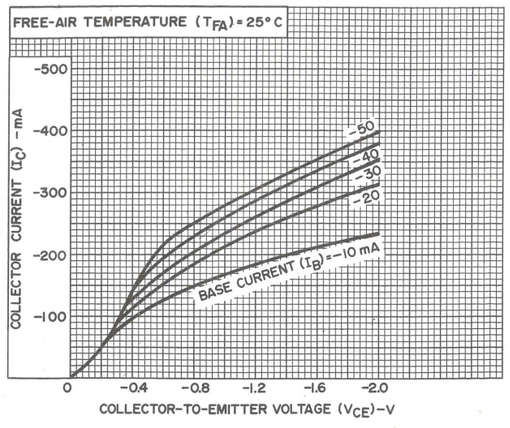

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Fig. 14

TYPICAL COLLECTOR CHARACTERISTICS
FOR TYPE 2N4037

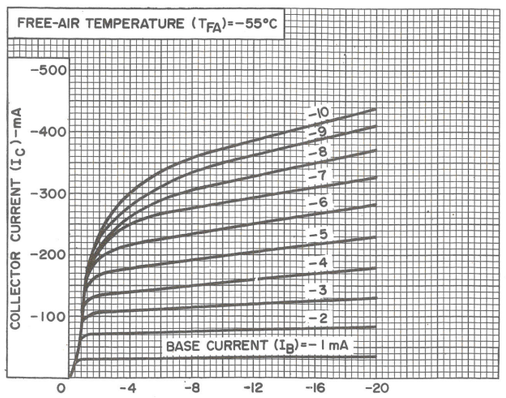

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Fig. 15

TYPICAL COLLECTOR CHARACTERISTICS
FOR TYPE 2N4037

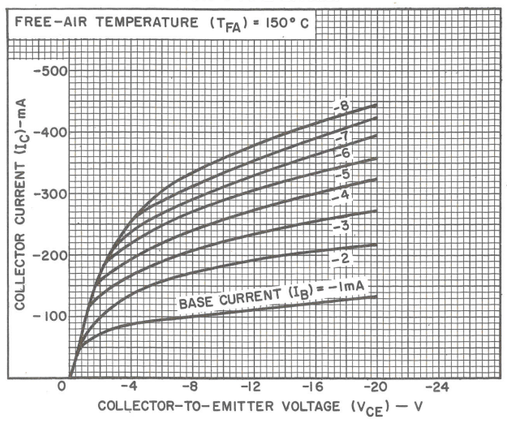

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Fig. 16

TYPICAL DC-BETA CHARACTERISTICS
FOR TYPE 2N4037

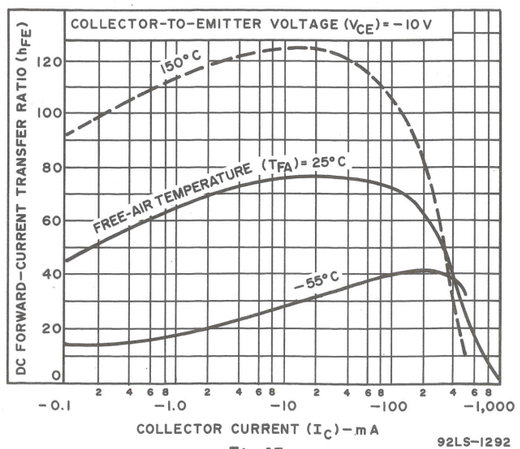

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Fig. 17

TYPICAL TRANSFER CHARACTERISTICS
FOR TYPE 2N4037

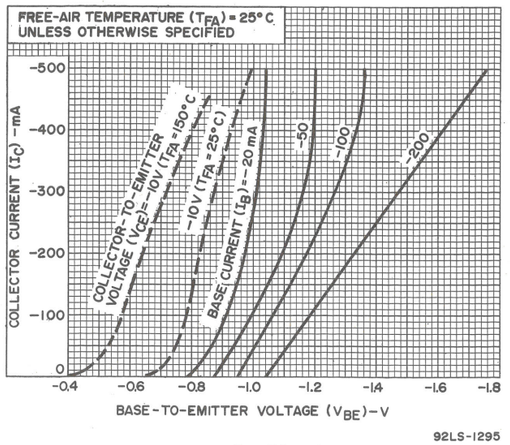

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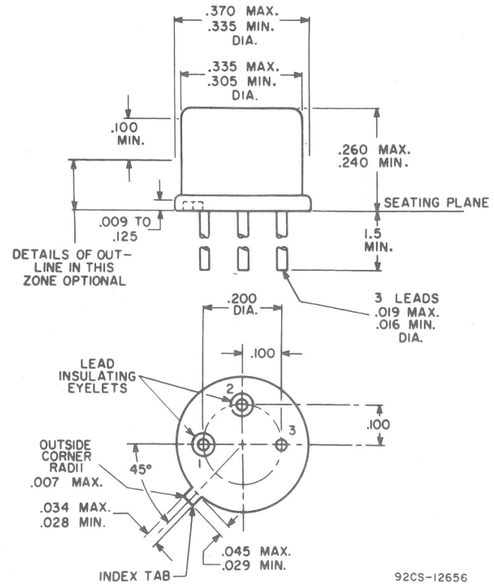
Fig. 18

DIMENSIONAL OUTLINE
FOR TYPES 2N4036 & 2N4037
JEDEC No. TO-5



Dimensions in Inches

TERMINAL CONNECTIONS
FOR TYPES 2N4036 & 2N4037

Lead No.1 - Emitter
Lead No.2 - Base
Case, Lead No.3 - Collector

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2N4036
2N4037